ANNOTATED CATALOGUE

OF

MINERALS.

BY

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Although it is not customary to precede an investigation by what may appear to be an index to the subject, it nevertheless seems desirable to prepare a brief statement of the different mineral occurrences at present known from the State. Of late the inquiries have been so many and frequent that a list of minerals, with accompanying notes, appears quite necessary at this time. The present list includes those minerals which have come under personal observation thus far, together with a few reported previously.

Although Iowa has never been known as a "mineral country," certain of its products have long been counted among the mineral resources of the State.

As early as the year 1700 a Frenchman by the name of Le Sueur made a voyage up the Mississippi river for the express purpose of finding valuable metals. And it is due to him that the first account is given of the occurrence of lead ore in the northwest.

A century later the first mining in the upper Mississippi lead region was begun by Julien Dubuque, near the present cite of the city now bearing his name. He obtained a grant from the Sacs and Foxes, which was confirmed by Carondelet, Governor of Louisiana, in 1788. For over twenty years, until his death, he carried on the work of mining in that region.

The first extensive mining by Americans began about 1827. Seven years later the War Department sent Featherstonhaugh, as United States Geologist, into this region. In 1839 D. D. Owen investigated the lead region of the upper Mississippi, in order to settle certain disputes in connection with land grants.

The first scientific consideration of the lead region was undertaken by Dr. J. C. Percival, in 1854, under the authority of the Wisconsin legislature.

During the last half century various other mineral products have been reported from the State. Some of these are of importance economically; some are not. Though among the earliest places in the upper Mississippi valley to receive attention mineralogically, no systematic investigation of Iowa's mineral resources has ever been accomplished.

Some of the minerals occurring in the State are known to have a very considerable commercial value, and will, necessarily, be the subject of special inquiry. Others, and probably the majority, will be found to have only a scientific interest. Many having little or no value from an economical standpoint are now attracting popular attention, and are causing a considerable expenditure of money every year, with absolutely no hope of any return. On the other hand, a number of deposits of very great economic importance are not being worked to the extent that they might. Or, they have received no notice whatever. In the work already begun on the mineral resources of the State, both economic and scientific aspects will be treated of at length.

LIST.

ELEMENTS.

Sulphur.—This mineral occurs in small quantities in the lead region of northeastern Iowa. It usually is found

in small, amorphous masses on galena. Occasionally bright crystals are noticed, some attaining a diameter of two millemeters. The following crystalographic planes have been made out: 0P, P, $\frac{1}{3}$P.

Iron.—Native iron occurs only in certain meteorites which have fallen at various times in the State.

Copper.—The discovery of native copper in small masses in different parts of the State has frequently given considerable local encouragement to seek amounts of commercial value. Considerable expense has been incurred from time to time in digging for paying deposits, but all the native copper found in Iowa occurs in drift, and hence has been transported by glaciers from the Lake Superior copper region. There is no reason to believe that paying deposits of this mineral will ever be found in Iowa.

Gold.—Considerable local excitement is frequently aroused by the reported discovery of small quantities of gold in various parts of the State. Many gravels, as in the neighborhood of Burlington for instance, yield, upon panning, small quantities of the yellow metal. There are also other gravels that will probably yield various amounts by similar treatment, but at the present state of our knowledge no hope need be entertained of ever obtaining this metal in quantities of commercial importance.

Mr. McGee's notes contain the following paragraph:

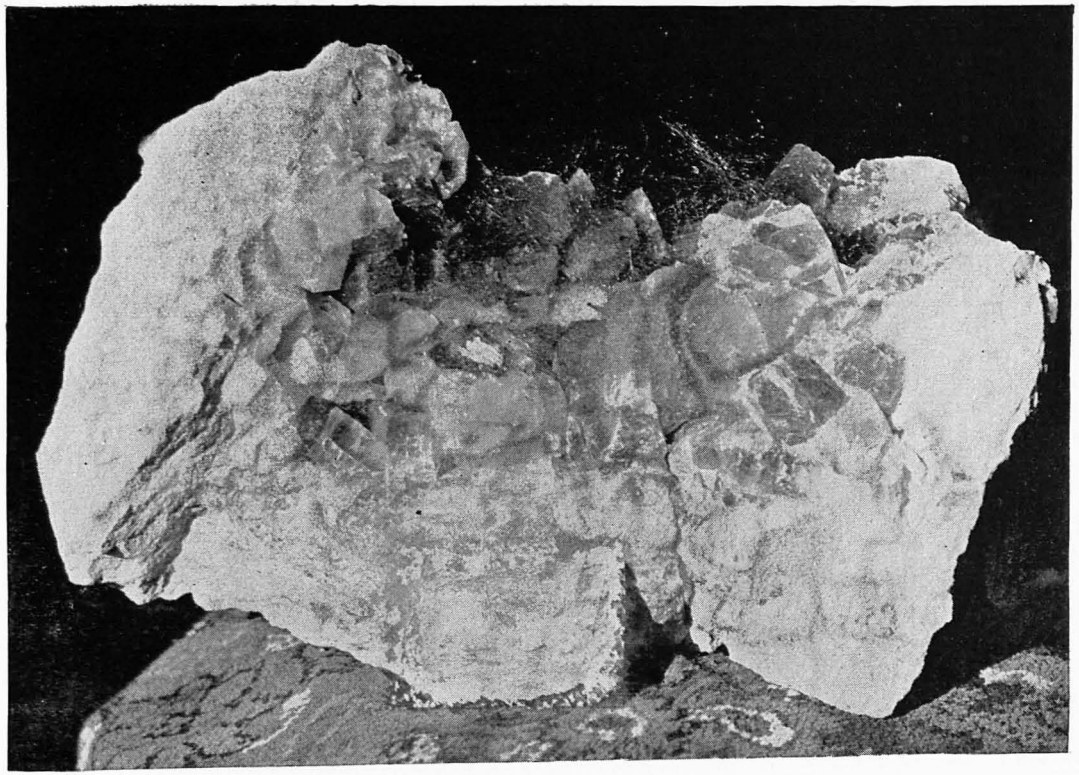
"An element of the glacial drift generally, throughout the entire basin, which is almost insignificant in volume but sometimes important in value, is triturated gold. This element occurs in Iowa, as elsewhere, commonly in exceedingly small quantity; but there is a considerable area in which the local conditions of deposition of the upper till

have led to such concentration that it may prove of economic value. The head-waters of the Volga rise in an elongated basin trending in the general direction of stream-flow, and drained through water-ways at first flowing in opposite directions, but later uniting in the lowest part of the basin a few miles west of Fayette, and thence finding their way through a narrow gorge in the northeastern rim of the basin, and so beyond the Niagara escarpment into the Turkey. Now this basin is a magnified similitude to the miner's pan, or rather the prospector's horn: and when the débris from the slightly auriferous crystalline rocks of the northwest was partly pushed and partly washed into and through the basin, the heavier gold was caught in its lower portion, and there remains to lure, if not to reward the prospector. About Brush Creek gold has been frequently found in such quantity that mining fevers have frequently broken out. In one case an experienced miner is reliably reported to have realized a dollar per day for some months in extracting the shining dust with a small rocker and with inadequate water supply. About Fayette, at Maynard, and indeed everywhere in the northeastern part of the basin, more or less gold has been found, and even in the gap cut by the Volga in the basin rim at Wadena, gold has been obtained in nearly paying quantities."

Silver.—The only known occurrence of this mineral is in very minute quantities in the lead ore of Dubuque. It has never assayed percentages high enough to pay for extracting.

SULPHIDES.

Sphalerite.—This mineral occurs most abundantly in Iowa associated with the galena deposits in the vicinity of Dubuque. For the most part it has been changed to the



MILLERITE ON CALCITE—KEOKUK.

silicate and carbonate of zinc, so that a large proportion of the metal is obtained from this ore. Iron is often contained in the Dubuque sphalerites. In the lead region of northeastern Iowa zinc blende seldom occurs showing the crystalographic faces. In the vicinity of Keokuk very good crystals of zinc are frequently met with in the geodes of that region, along with other metallic minerals.

Millerite.—For a number of years past there have been noted occasionally in "geode collections" examined from different parts of Lee county, in southeastern Iowa, certain specimens containing clear calcite crystals, traversed in different directions by minute yellowish filaments after the manner of the familiar *fleches d'amour*—the rutile needles in quartz. Plate x is a photograph of a large specimen. Recently, in opening a quarry near the city of Keokuk, in the compact Keokuk limestone some feet below the regular "geode bed," numerous cavities were encountered, varying from a few up to twenty inches. These hollows have large, thickly set rhombohedrons of calcite jutting out toward the center. The faces are brightly polished and the edges are sharply cut. On some of the calcites have been found beautiful tufts of closely arranged, brass-yellow needles of millerite pointing from the center of attachment, in all directions, to a distance of one-half to two and one-half inches. In some of the examples the tufts are made up of hundreds of filaments, often so close together that needles of the different branches are interwoven, forming a dense matted mass. Often a large, perfectly transparent calcite has a tuft of long millerites completely inclosed in it; or a part of the tuft may be embedded in the lime crystal, the extremities of the needles being left projecting outside. Some of the finest spec-

imens of calcite thickly covered with the nickel-bearing mineral weigh over fifty pounds.

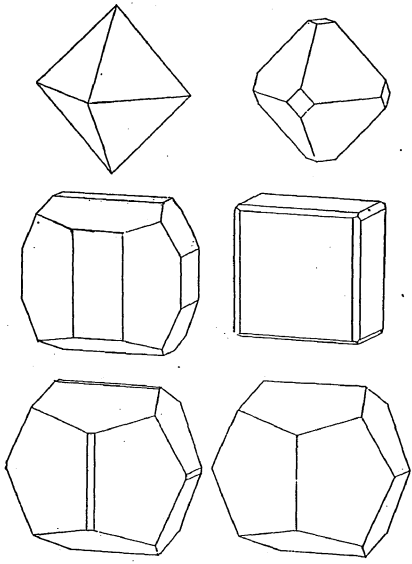
Similar calcites abundantly charged with millerite needles are also found in the neighborhood of Fort Madison. At this place the needles often adhere to one another, forming masses weighing several ounces.

Pyrite.—Quite recently there have been obtained from limestone cavities in Lee county some small but very perfect pyrite crystals. The faces are brightly reflecting and meet in sharply defined edges. The more common crystalographic forms are the pentagonal dodecahedron or pyritohedron and cube, in combination, with all gradations between the two. Though small, they are perhaps the most perfect crystals of this mineral found up to the present time in the State.

From the Kinderhook clays of Burlington were obtained a number of bright-faced specimens showing the cube with the corners very slightly truncated by the octohedron. These sometimes occur singly, sometimes in aggregates of considerable size.

In the black bituminous shales of the Lower Coal Measures at Des Moines occur some rather remarkable specimens of pyrite. The form is the octohedron, modified very slightly by the cubic faces. In the direction of the crystalographic axes the octohedral corners have become greatly extended from the center, forming long series of octohedrons partly inclosed in one another, the terminal one in each of the six sets being almost perfect, except at the end of attachment. With one series pointing directly in front and the opposite one directly behind, the remaining arms form a slender Swiss cross, whose dimensions are sometimes from four to six inches. These may be regarded as a large number of subindividuals forming parallel growths, each

individual represented by a thin plate between each pair of re-entrant angles. The terminal octohedrons are often an inch along the edges. If the skeleton crystal



Figures 21-26. Pyrite: Upper Two from Dubuque; Lower Four from Fort Madison.

were completely filled out, the octohedral edges would measure five inches or more.

The pyrite crystals from the lead region usually appear in small, perfectly-formed octohedrons.

Pyrite is perhaps the most widely distributed of minerals in Iowa, occurring in all formations in greater or less abundance. It is especially encountered in the Coal Measures, forming the "sulphur" of the coal and accompanying shales. In this case it often assumes concretionary bands. It is also found preserving fossils of all kinds in the bituminous shales. It replaces the lime in molluscan shells; in some forming a coating of pyrite, while the interior retains all the calcic constituents. From this stage all degrees of replacement by pyrite occur until the original lime salts have completely disappeared. In Marion county there have lately been found lepidodendrons in which all the tissues are perfectly replaced by pyrite. All the minute structures of the vegetable fibers and the fibro-vascular bundles are preserved as perfectly as when the plants were living.

Marcasite occurs abundantly in the Coal Measures, and chemically is essentially the same as pyrite, but crystallizes in the orthorhombic instead of the regular system. In similar occurrences it is readily distinguished from pyrite by its paler color and by decomposing more readily upon ordinary exposure to weathering influences.

Galenite.—This is the only ore of lead found in the upper Mississippi region which is mined profitably. It often contains minute traces of silver, but never in such quantities as to be of economic importance. In the Dubuque region this ore was mined long before it was anywhere else in the upper Mississippi valley. Its discovery dates back as early as 1700, though systematic mining was not begun till nearly a century later. The deposits of this mineral in northeastern Iowa are probably much more extensive than have been supposed. Inasmuch as the mineral deposits of this region are being made the subject of special

investigation, nothing farther concerning their economic importance need be said in the present connection.

The galena of the Dubuque region ususally occurs in cubes ("dice mineral" of miners) with regular cubical cleavage apparent everywhere. Cubes five inches along the edges and weighing over fifteen pounds have been found at various places. Usually the cubes have the corners truncated by small faces of the octohedron. The latter is rarely found without some combination of the cube.

SULPHO-SALTS.

Chalcopyrite is found in small but very perfect crystals in geodes near Keokuk. The crystal form is the tetrahedron with the corners very much truncated by the opposite tetrahedral faces.

OXIDES.

Quartz is widely distributed throughout the State. It occurs in well-defined crystals in the neighborhood of Keokuk and other places where cavities are formed in limestones. The large majority of the geodes of southeastern Iowa are lined with well-defined crystals made up of long prisms attached at one end, while the other extremity is terminated by the fundamental pyramid. Occasionally quartz-crystals are observed with both ends truncated by well-defined pyramids. Not unfrequently the outside of these geodes are made up of the form known as *chalcedony*. This form sometimes makes up the entire geode, the interior forming botryoidal masses.

Wad (Manganese oxide).—Impure masses are found frequently in connection with the lead ores of Dubuque.

Hematite is widely distributed through the shales and sandstones of the Coal Measures, but usually not in paying quantities. It also occurs in many sandstones as the

chief cementing material. From Allamakee county quantities of commercial importance have been reported. It frequently occurs in small pockets in Jasper county. It is also found as a decomposition product of pyrite, often retaining the cubical habit of the pyrite crystals. The hematite deposits in sandstone have been used in the manufacture of metallic paints in the neighborhood of Monroe, in Jasper county. From this locality there has recently been placed upon the market nearly one thousand tons of this paint.

Magnetite is found in small quantities scattered through the drift of the State.

Rutile.—In certain geodes in the vicinity of Keokuk have been found numerous small crystals which appear to be good crystallizations of this mineral.

HYDROXIDES.

Limonite is quite abundant throughout the State, usually in a very impure form. It has also been found in pseudomorphs after pyrite.

NITRATES.

Nitre.—This mineral is reported from Lansing in small needle-like crystals which are deposited on the surface of the Cambrian sandstones.

CARBONATES.

Calcite is widely distributed in fine crystallizations everywhere throughout the lead region of Dubuque; also as beautiful examples of satin-spar and stalactites. The cavities in rocks of the Coal Measures are often lined with numerous small calcite crystals in the sharp scalenohedrons, commonly known as dogtooth spar. The geode region of southeastern Iowa also furnishes very beautiful

crystals of this mineral three or four inches across. The rhombohedron, $\frac{1}{2}$R, with very short prisms, is frequently found lying in geodes of quartz. A very large number of different rhombohedrons and scalenohedrons occur on these calcites. The very rare form R, the fundamental or cleavage rhombohedron, has been found in the vicinity of Keokuk. Beautiful specimens showing vicinal planes have also been obtained. Some of the crystals are perfectly transparent, like Iceland spar.

Aragonite.—This is chemically the same as calcite, but has a different form of crystallization. It has been found in small prismatic crystals in the vicinity of Dubuque.

Dolomite.—Beautiful crystals are sometimes found lining geodes from the vicinity of Keokuk. Cavities in impure bituminous limestone in the vicinity of Fort Dodge have also been found lined with fine crystals of a pink color, and with a few large calcite individuals scattered over the surface.

Smithsonite (Zinc Carbonate, $ZnCO_3$, "Drybone"). This is the commonest of the zinc ores occurring in the lead and zinc region of Dubuque and is derived from the zinc blende. Until recently this mineral has been thrown aside as useless, but the old refuse mounds are now being worked for this ore. Some fine crystal examples have been reported from Dubuque, but as a rule crystals are quite scarce.

Siderite is rather common in various parts of the State, especially through the coal region, and often forms impure beds several feet in thickness. Well defined crystals are sometimes met with showing the fundamental rhombohedron. The finest thus far observed are dark brown specimens from Muchakinock, Mahaska county.

Cerussite.—The carbonate of lead occurs throughout the Dubuque lead region, but is not found in sufficient

quantity to be valued as an ore. It is often found in reniform and stalactitic masses. Small but finely crystallized specimens also have been observed associated with galena.

SULPHATES.

Barytes is found commonly associated with the lead and zinc ores in the Dubuque region. Good crystallizations of tabular form and bluish tints are of not unfrequent occurrence. This mineral in small bluish tablets has also been observed at Waverly, in Bremer county. It has also been found at various localities within the Coal Measure area.

Celestite.—The only known locality where this mineral is found is in the vicinity of Fort Dodge, where it occurs in considerable masses, forming sheets one to several inches in thickness between shales. Specimens showing very perfect crystallographic planes have been observed; usually, however, the masses are columnar, with light bluish tints.

Anglesite is found in small crystals in the Dubuque lead region.

HYDROUS SULPHATES.

Gypsum.—The massive variety occurs in an extensive deposit in and around Fort Dodge, where it has been largely quarried. The layers have a thickness of from two to thirty feet. In 1891 fifty thousand tons of land plaster and stucco were made in Webster county.

Crystallized Gypsum is of rather common occurrence in many of the Coal Measure shales of central Iowa. Some specimens disclosed a short time ago seem worthy of special note since they are uncommonly perfect and are found in large numbers. The edges are sharply cut and the faces brilliant. The crystallographic forms are $_{\infty}P\breve{\infty}$, $_{\infty}P$, and

P_{∞}. They assume the well known diamond shapes, with beveled edges. Not infrequently individuals contain very distinct "shadow" crystals. In some localities the crystals form swallow-tailed twins and become greatly elongated in the direction of the vertical axis. Examples of this kind sometimes attain a length of six to eight inches.

This variety is widely distributed through the clay shales of the State. Large crystals are especially abundant in the Cretaceous shales of northwestern Iowa. Tabular crystals and bunches of fibrous gypsum occur associated with the lead deposits of Dubuque.

Melanerite (Copperas, Sulphate of Iron).—It is widely distributed in small quantities through the shales of the Coal Measures, where it is often seen as an efflorescence.

Epsomite.—This is found as an efflorescence or incrustation in sheltered places where the Kinderhook shales are exposed at Burlington. Being very soluble, it is readily washed away by rains as fast as formed.

Alum in small quantities has been reported from near Albia, in Monroe county.

SILICATES.

Calamine is found in the Dubuque lead region, where it forms impure mixtures with Smithsonite in clay.

Kaolin.—Very pure samples of this mineral are said to occur as a fine white powder in the geodes of southeastern Iowa.

HYDROCARBONS.

Petroleum.—Although widely disseminated through the rocks, no paying quantities of mineral oil have yet been found within the limits of the State. Near Fort Madison geodes are found filled with this material somewhat hardened.

Mineral Coal.—This is by far the most valuable of Iowa's mineral products. The value of the production for the past fiscal year amounted to over seven and one-half millions of dollars. It is chiefly of the bituminous variety, though a small amount of cannel coal is found in some localities.